

We claim:

- 1 1. A method for generation of hydrogen gas, the method comprising:  
2 contacting a hydrocarbon fuel with iodine to provide a mixture thereof; and  
3 heating the mixture thereby generating hydrogen gas.
- 1 2. The method of claim 1, wherein the hydrocarbon fuel is a cycloalkane or an aryl  
2 compound, or mixtures thereof.
- 1 3. The method of claim 2, wherein the hydrocarbon is a cycloalkane compound.
- 1 4. The method of claim 3, wherein the cycloalkane is cyclohexane.
- 1 5. The method of claim 2, wherein the hydrocarbon is an aryl compound.
- 1 6. The method of claim 5, wherein aryl compound is benzene.
- 1 7. The method of claim 2, wherein the hydrocarbon is a mixture of a cyclohexane and an  
2 aryl compound selected from the group consisting of benzene and toluene.
- 1 8. The method of claim 1, wherein the hydrocarbon fuel and iodine are in a ratio of about  
2 1:0.001 to about 1:2 moles/moles.
- 1 9. The method of claim 8, wherein the ratio is about 1:0.01 to about 1:0.25 moles/moles.
- 1 10. The method of claim 1, wherein the mixture is heated to a temperature of about 60°C to  
2 about 500°C.
- 1 11. The method of claim 10, wherein the mixture is heated to a temperature greater than  
2 about 80°C to about 100°C.

- 1 12. The method of claim 10, wherein the mixture is heated to a temperature greater than  
2 about 80°C.
- 1 13. The method of claim 1, further comprising exposing providing the mixture to increased  
2 pressure.
- 1 14. The method of claim 13 wherein the pressure is greater than about 1 atmosphere, and less  
2 than about 250 atmospheres.
- 1 15. The method of claim 14, wherein the pressure is greater than about 2 atmospheres.
- 1 16. A method comprising the steps of:  
2 providing in a reaction container a composition comprising a hydrocarbon fuel and  
3 iodine; and  
4 causing the composition to react in the container to generate hydrogen gas.
- 1 17. The method of claim 16, further comprising recovering the hydrogen gas.
- 1 18. The method of claim 17, further comprising using the recovered hydrogen gas as a fuel.
- 1 19. The method of claim 16, wherein the hydrocarbon fuel is selected from the group  
2 consisting of cyclohexane and benzene, or mixtures thereof.
- 1 20. The method of claim 19, wherein the hydrocarbon fuel is cyclohexane.
- 1 21. The method of claim 20, wherein the hydrocarbon fuel is benzene.
- 1 22. The method of claim 16, wherein the hydrocarbon fuel and iodine are in a ratio of about  
2 1:0.001 to about 1:2 moles/moles.

- 1 23. The method of claim 22, wherein the ratio is about 1:0.01 to about 1:0.25 moles/moles.
- 1 24. The method of claim 23, wherein the ratio is about 1:0.05 to about 1:0.2 moles/moles.
- 1 25. A fuel cell system comprising:  
2 a hydrogen gas generator of claim 16; and  
3 a fuel cell capable of generating electricity by making use of hydrogen gas as a fuel.
- 1 26. The fuel cell of claim 25, wherein the hydrogen gas is generated by an increase in  
2 temperature and /or an increase in pressure.
- 1 27. The fuel cell of claim 26, wherein the hydrogen gas is generated by an increase in  
2 temperature and an increase in pressure.
- 1 28. The fuel cell of claim 26, wherein the hydrogen gas is generated by first increasing the  
2 temperature and then increasing the pressure.
- 1 29. The fuel cell of claim 26, wherein the hydrogen gas is generated by first increasing the  
2 pressure and then increasing the temperature.
- 1 30. The fuel cell of claim 26, wherein the temperature is increased to about 80°C or higher.
- 1 31. The fuel cell of claim 26, wherein the pressure is increased to greater than about 2  
2 atmospheres.
- 1 32. The fuel cell of claim 26, wherein the temperature is between about 80°C and 100°C, and  
2 the pressure is between about 2 atmospheres and 2.5 atmospheres.